Technical Program

Hybrid Seminar

DATE	TIME	VENUE
25 August 2026 (Tuesday)	14:00 - 18:00 (Singapore Time, UTC+8)	NUS E7-03-07

Admission is free while online register is required via Zoom by 23:59 on 23 August 2026 (UTC+8):
https://Marina Forum Series: AntennAI 2026 Registration

TIME	SESSION	SPEAKER / TOPIC
14:00-14:10	Opening	**Prof. Zhi Ning Chen (onsite), National University of Singapore, Singapore**
14:10-15:00	KEYNOTE 1	**Prof. Peiqin Liu (onsite), National University of Singapore, Singapore** *Prior Knowledge-Guided Deep Learning-Enabled Generative Antenna Design*
15:00-15:50	KEYNOTE 2	**Prof. Haiming Wang (online), Southeast University, China** *Machine Learning-Assisted Circuit-Network-Field Co-Optimization for High-Degree-of-Freedom Smartphone Antenna Design*
15:50-16:10	Tea Break	
16:10-17:00	KEYNOTE 3	**Prof. Ming Shen (online), Aalborg University, Denmark** *Toward Autonomous Antenna Engineering with Machine Learning*
17:00-17:50	KEYNOTE 4	**Prof. Slawomir Koziel (online), Reykjavik University, Iceland** *Computational Intelligence for Unsupervised Design, Modeling, and Optimization of Antennas*
17:50-18:00	Closing	**Prof. Zhi Ning Chen (onsite), National University of Singapore, Singapore**

Organizing Committee:

General Chair:
Prof. Zhi Ning CHEN, National University of Singapore

Series Chair:
Prof. Peiqin LIU, National University of Singapore

Technical Program Chair:
Dr. Terence Shie Ping SEE, A* STAR
Dr. Yanhe LYU, Nanyang Technological University

Publication Chair:
Dr. Bo ZHANG, National University of Singapore
Dr. Danyu YANG, National University of Singapore

Logistic Chair:
Dr. Yang HONG, National University of Singapore
Dr. Yu KUANG, National University of Singapore

Secretary:
Ms. Fanglin REN, National University of Singapore
Mr. Shuai LIU, National University of Singapore
Mr. Soon Ming SIEW, National University of Singapore

Connect Persons:
Fanglin Ren: renfanglin@u.nus.edu
Shuai Liu: liushuai@u.nus.edu

Organizer:

NUS National University of Singapore | Advanced Research and Technology Innovation Centre, College of Design and Engineering

Technical Sponsors:

IEEE SINGAPORE RFID CHAPTER

IEEE SINGAPORE MTT/AP JOINT CHAPTER

NUS National University of Singapore, Department of Electrical & Computer Engineering

KEYNOTE 01

Prior Knowledge-Guided Deep Learning-Enabled Generative Antenna Design

Peiqin Liu

Research Assistant Professor

National University of Singapore

ABSTRACT

With the rapid development of artificial intelligence (AI), antenna engineering is undergoing a significant transformation. Deep learning (DL) algorithms have substantially increased the degrees of freedom (DoFs) available for generative antenna design (GAD), opening new opportunities for expanding the boundaries of antenna engineering. This talk will highlight recent advances in DL-enabled synthesis methods for meta-antennas. Prior knowledge (PK), including fundamental electromagnetic principles and practical antenna-design expertise, is deliberately incorporated into DL algorithms to guide and accelerate the synthesis of high-performance meta-antennas. The proposed PK-DL synthesis approach overcomes limitations of conventional design techniques and pushes beyond the performance ceilings of traditional metalens antennas. Two representative metalens antennas will be presented to demonstrate the effectiveness and potential of the PK-DL synthesis method. The integration of PK-DL synthesis with meta-antennas not only represents a significant advancement in GAD but also points toward new possibilities for the future development of antenna engineering.

BIOGRAPHY

Peiqin Liu received the B.E. degree from the University of Electronic Science and Technology of China in 2014 and the Ph.D. degree from Tsinghua University, Beijing, China, in 2019. Since 2019, he has been with the National University of Singapore, where he initially served as a Research Fellow and was promoted to Research Assistant Professor in 2024. His current research interests include metamaterials, antenna theory, and artificial intelligence for electromagnetics, with a particular focus on the development of novel metasurfaces and antenna arrays using deep learning techniques. Dr. Liu has authored and co-authored more than 50 technical papers published in international journals and conference proceedings and holds five granted Chinese patents. His honors include the Young Scientist Award at the 2026 URSI General Assembly and Scientific Symposium (URSI GASS), the Best Poster Award at the AI for Science and Nobel Turing Challenge Initiative (AI4Sci/NTCI) Conference in 2024, the Young Antenna Scientist Award at the 2023 Singapore Workshop on Antennas (SWA).

MAIN REFERENCES

[1] Z. N. Chen, P. Liu, Y. Kuang, Y. Lyu, B. Zhang, D. Yang, Y. He, and J.-M. Jin, “Deep Learning-Enabled Generative Antenna Design: Review and Prospects,” *IEEE Transactions on Antennas and Propagation*, vol. 74, no. 5, pp. 4051-4066, May 2026.

[2] P. Liu, L. Chen, and Z. N. Chen, “Prior-Knowledge-Guided Deep-Learning-Enabled Synthesis for Broadband and Large Phase Shift Range Metacells in Metalens Antenna,” *IEEE Transactions on Antennas and Propagation*, vol. 70, no. 7, pp. 5024-5034, Jul. 2022.

[3] P. Liu and Z. N. Chen, “Full-Range Amplitude-Phase Metacells for Sidelobe Suppression of Metalens Antenna Using Prior-Knowledge-Guided Deep-Learning-Enabled Synthesis,” *IEEE Transactions on Antennas and Propagation*, vol. 71, no. 6, pp. 5036-5045, Jun. 2023.

[4] P. Liu and Z. N. Chen, “Prior-Knowledge-Guided Transformer-Model-Based Synthesis for Active S-Parameter Extrapolation in Linear Antenna Arrays,” *IEEE* Transactions *on Antennas and Propagation*, vol. 74, no. 5, pp. 4401-4413, May 2026.

[5] P. Liu, J. Shi, and Z. N. Chen, “Prior Knowledge-Guided Deep Learning-Assisted Optimization Method for Broadband Metasurface Mushroom Antenna,” *Radio Science Letters*, *in press*.

[6] Y. Lyu, D. Tong, and Z. N. Chen, “Dual-Branch Tandem Model-based Generative Design of Miniaturized Broadband Metantennas for Wideband Wide-Angle Scanning Array,” *IEEE Transactions on Antennas and Propagation*, *early access*.

[7] Y. Lyu and Z. N. Chen, “Prior Knowledge-Guided Generative Design of Pixelated Microwave Metastructures,” *IEEE Microwave Magazine*, *early access*.

[8] Y. Kuang, Q. S. Cheng, and Z. N. Chen, “Chu-Limit-Guided Decomposition-Based Multiobjective Large-Scale Optimization for Generative Broadband Electrically Small Antenna Design,” *IEEE Transactions on Antennas and Propagation*, vol. 74, no. 4, pp. 3385-3396, Apr. 2026.

[9] Y. Lyu, Y. Hong, and Z. N. Chen, “Generative Deep Learning-Enabled Multiobjective Synthesis of Dual-Polarized Wide-Angle Loop-Family Frequency-Selective Surfaces,” *IEEE Transactions on Antennas and Propagation*, vol. 74, no. 1, pp. 456-466, Jan. 2026.

[10] Y. Lyu, T. H. Gan, and Z. N. Chen, “TE–TM Balanced Wide-Angle Metacells for Low Scan-Loss Metalens Antenna Using Prior Knowledge-Guided Generative Deep Learning-Enabled Method,” *IEEE Transactions on Antennas and Propagation*, vol. 73, no. 5, pp. 2940–2949, May 2025.

[11] Z. N. Chen, P. Liu, and Y. Lyu, “Prior Knowledge in Deep Learning-Enabled Generative Design of Metalens Antennas,” *2025 International Conference on Electromagnetics in Advanced Applications (ICEAA)*, Palermo, Italy, 2025, pp. 184-187.

[12] Y. Hong, W. Shao, Y. -H. Lv, B. -Z. Wang, L. Peng, and B. Jiang, “Knowledge-Based Neural Network for Thinned Array Modeling With Active Element Patterns,” *IEEE Transactions on Antennas and Propagation*, vol. 70, no. 11, pp. 11229-11234, Nov. 2022.

KEYNOTE 02

Machine Learning-Assisted Circuit-Network-Field Co-Optimization for High-Degree-of-Freedom Smartphone Antenna Design

Haiming Wang

Professor

State Key Laboratory of Millimeter Waves and School of Information Science and Engineering, Southeast University

ABSTRACT

To meet advanced performance requirements, modern smartphone antennas frequently adopt circuit-network-field (CNF) co-design, which introduces challenges such as strong variable coupling, high sensitivity, and vast search spaces. Traditional machine learning-assisted optimization (MLAO) methods, typically focused on geometric structures, exhibit limited capability in addressing these complexities. We propose a machine learning-assisted circuit-network-field co-optimization (MLA-CNFCO) method incorporating microwave network analysis. First, logarithmic sampling is applied to circuit variables to reshape the sample space, alleviating issues related to nonlinear impedance and high sensitivity. A proportion-modeling approach is then introduced to enhance the prediction accuracy of radiation pattern surrogate models. To accelerate the process, a microwave network analytical solution (MNAS) is employed to calculate reflection coefficients directly, enabling the rapid identification of superior initial solutions. These coefficients are integrated as constraints, significantly narrowing the search space. Finally, the co-design problem is effectively decoupled by embedding microwave network-based circuit optimization within potential-based geometry optimization. The effectiveness of the MLA-CNFCO framework is validated through the design, fabrication, and measurement of high-performance smartphone antennas.

BIOGRAPHY

Haiming Wang was born in 1975. He received the B.S., M.S., and Ph.D. degrees in electrical engineering from Southeast University, Nanjing, China, in 1999, 2002, and 2009, respectively. He joined the School of Information Science and Engineering and the State Key Laboratory of Millimeter Waves, Southeast University, Nanjing, China, in 2002, and is currently a Chair Professor. He is also a part-time professor with the Pervasive Communication Research Center, Purple Mountain Laboratories, Nanjing, China. He has authored and co-authored over 60 technical publications in IEEE TRANSACTIONS ON ANTENNAS AND PROPAGATION and other peer-reviewed academic journals. Currently, he is an expert in China 6G task force research supported by the Ministry of Science and Technology of China. Professor Wang has authored and co-authored more than 80 patents and 60 patents have been granted. He was awarded for contributing to the development of IEEE 802.11 by the IEEE Standards Association. His current research interests include AI-powered antenna and radiofrequency design technologies (iART), nonlinear wireless communications (NLWC), and AI-powered integrated communications, sensing, and positioning technologies (iCASP).

MAIN REFERENCES

[1] W. Gong, Q. Wu, W. Chen, L. Sun, H. Wang, H. Wang, and W. Hong, “Machine Learning-Assisted Circuit-Network-Field Co-Optimization for Metal-Bezel Smartphone Antenna Design,” *IEEE Transactions on Antennas and Propagation*, vol. 74, no. 8, pp. 7860-7871, Aug. 2026.

[2] Q. Wu, X. Mo, P. Liu, J. You, Z. N. Chen, W. Hong, and H. Wang, “Graphic Antenna: Reconciling Performance, Freedom, and Efficiency Using Hybrid Knowledge-Guided and Data-Driven Technology,” *IEEE Journal of Selected Topics in Electromagnetics*, Antennas and Propagation, vol. 2, pp. 191-212, 2026.

[3] Q. Wu, B. Han, W. Chen, C. Yu, G. Lu, H. Wang, and W. Hong, “Composite Merit-Oriented Antenna Design Using Gray-Box Machine Learning-Assisted Optimization,” *IEEE Transactions on Antennas and Propagation*, vol. 73, no. 12, pp. 9773–9786, Dec. 2025.

[4] B. Han, Q. Wu, C. Yu, H. Wang, and W. Hong, “Low-Wind-Load Broadband Dual-Polarized Antenna and Array Designs Using Sequential Multiphysics Machine-Learning-Assisted Optimization,” *IEEE Transactions on Antennas and Propagation*, vol. 73, no. 1, pp. 135-148, Jan. 2025.

[5] W. Chen, Q. Wu, B. Han, C. Yu, H. Wang, and W. Hong, “Efficient Incremental Variable-Fidelity Machine-Learning-Assisted Hybrid Optimization and Its Application to Multiobjective Antenna Design,” *IEEE Transactions on Antennas and Propagation*, vol. 72, no. 12, pp. 9347-9354, Dec. 2024.

[6] J. Wei, W. Chen, Q. Wu, G. Lu, W. Gao, L. Wang, M. Li M, and H. Wang, “Microwave Network-Assisted Analysis and Machine Learning-Assisted Synthesis of Arbitrarily Tapped Coils and Its Application to On-Chip Ultrawideband ESD Protection Circuits,” *IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems*, vol. 43, no. 12, pp. 4386-4397, Dec. 2024.

[7] Q. Wu, W. Chen, C. Yu, H. Wang, and W. Hong, “Machine-Learning-Assisted Optimization for Antenna Geometry Design,” *IEEE Transactions on Antennas and Propagation*, vol. 72, no. 3, pp. 2083-2095, Mar. 2024.

[8] W. Chen, Q. Wu, C. Yu, H. Wang, and W. Hong, “Multibranch Machine Learning-Assisted Optimization and Its Application to Antenna Design,” *IEEE Transactions on Antennas and Propagation*, vol. 70, no. 7, pp. 4985–4996, Jul. 2022.

[9] Q. Wu, W. Chen, C. Yu, H. Wang, and W. Hong, “Multilayer Machine Learning-Assisted Optimization-Based Robust Design and Its Applications to Antennas and Array,” *IEEE Transactions on Antennas and Propagation*, vol. 69, no. 9, pp. 6052-6057, Sep. 2021.

[10] Q. Wu, H. Wang, and W. Hong, “Multistage Collaborative Machine Learning and its Application to Antenna Modeling and Optimization,” *IEEE Transactions on Antennas and Propagation*, vol. 68, no. 5, pp. 3397-3409, May 2020.

KEYNOTE 03

Toward Autonomous Antenna Engineering with Machine Learning

Ming Shen

Associate Professor

Department of Electronic Systems, Aalborg University, Denmark

ABSTRACT

Machine learning is opening a new path toward greater automation in antenna and electromagnetic engineering. Rather than focusing primarily on optimizing antenna performance, this talk explores how AI can automate parts of the design process itself—from interpreting design requirements and generating candidate structures to interacting with electromagnetic simulation tools, analyzing results, and supporting iterative design decisions. Recent progress in machine-learning-assisted design automation will be discussed, together with the emerging role of large language models and agentic AI. The talk will also highlight key challenges toward more autonomous antenna engineering, including physical consistency, reliable verification, generalization, and effective human–AI collaboration.

BIOGRAPHY

Ming Shen is an Associate Professor in the Department of Electronic Systems at Aalborg University, Denmark, where he leads the AI RF Sensors group. He received his Ph.D. in Wireless Communications from Aalborg University in 2010. His research interests include machine learning, wireless systems, low-power electronics, and sensing, with an increasing emphasis on AI-enabled design and engineering automation. He has served as PI or Co-PI on several major Danish national research projects, with a combined project portfolio exceeding EUR 100 million, and has published more than 200 journal and conference papers. He is an IEEE Senior Member and received the Teacher of the Year Award from the Department of Electronic Systems at Aalborg University in 2022.

MAIN REFERENCES

[1] Z.H. Wei, Z. Zhou, P. Wang, J. Ren, Y. Yin, G. F. Pedersen, and M. Shen, “Fast and Automatic Parametric Model Construction of Antenna Structures Using CNN–LSTM Networks,” *IEEE Transactions on Antennas and Propagation*, vol. 72, no. 2, pp. 1319-1328, Feb. 2024.

[2] Z.H. Wei, Z. Zhou, P. Wang, J. Ren, Y. Yin, G. F. Pedersen, and M. Shen, “Automated Antenna Design via Domain Knowledge-Informed Reinforcement Learning and Imitation Learning”, *IEEE Transactions on Antennas and Propagation*, vol. 71, no. 7, pp. 5549-5557, Jul. 2023.

[3] Z. Zhou, Z. Wei, T. Abdullah, J. Ren, Y. Yin, G. F. Pedersen, and M. Shen, “A High-Quality Data Acquisition Method for Machine Learning Based Design and Analysis of Electromagnetic Structures,” *IEEE Transactions on Microwave Theory and Techniques*, vol. 71, no. 10, pp. 4295-4306, Oct. 2023.

[4] Z. Zhou, Z. Wei, J. Ren, Y. Yin, G. F. Pedersen and M. Shen, “Transfer-Learning-Assisted Multielement Calibration for Active Phased Antenna Arrays,” *IEEE Transactions on Antennas and Propagation*, vol. 71, no. 2, pp. 1982-1987, Feb. 2023.

[5] Z. Zhou, Z. Wei, J. Ren, Y. Yin, G. F. Pedersen and M. Shen, “Representation Learning-Driven Fully Automated Framework for the Inverse Design of Frequency-Selective Surfaces,” *IEEE Transactions on Microwave Theory and Techniques*, vol. 71, no. 6, pp. 2409-2421, Jun. 2023.

[6] Z.H. Wei, Z. Zhou, J. Ren, Y. Yin, G. F. Pedersen, and M. Shen, “Fully Automated Design Method Based on Reinforcement Learning and Surrogate Modelling for Decoupling Metasurfaces,” *IEEE Transactions on Antennas and Propagation*, vol. 71, no. 1, pp. 660-671, Jan. 2023.

[7] Z. Zhou, Z.H. Wei, J. Ren, Y. Yin, G. F. Pedersen, and M. Shen, “Two-Order Deep Learning for Generalized Synthesis of Radiation Patterns for Antenna Arrays,” *IEEE Transactions on Artificial Intelligence*, vol. 4, no. 5, pp. 1359-1368, Oct. 2023.

[8] Z.H. Wei, Z. Zhou, P. Wang, J. Ren, Y. Yin, G. F. Pedersen, and M. Shen, “Equivalent Circuit Theory-Assisted Deep Learning for Accelerated Generative Design of Metasurfaces,” *IEEE Transactions on Antennas and Propagation*, vol. 70, no. 7, pp. 5120-5129, Jul. 2022.

[9] Z. Zhou, Z. Wei, J. Ren, Y. Y.X. Sun, Yin, G. F. Pedersen, and M. Shen, “Bayesian-Inspired Sampling for Efficient Machine-Learning-Assisted Microwave Component Design,” *IEEE Transactions on Microwave Theory and Techniques*, vol. 72, no. 2, pp. 996-1007, Feb. 2024.

[10] P. Wang, Z.N. Li, Z.H. Wei, T. Wu, C. Luo, W. Jiang, T. Hong, Y. Li, G. F. Pedersen and M. Shen, “Space-Time-Coding Digital Metasurface Element Design Based on State Recognition and Mapping Methods with CNN-LSTM-DNN,” *IEEE Transactions on Antennas and Propagation*, vol. 72, no. 6, pp. 4962-4975, Jun. 2024.

[11] P. Wang, Z.H. Wei, T. Wu, W. Jiang, T. Hong, G. F. Pedersen and M. Shen, “A Machine Learning Framework for the Design of STCDME Structures in RIS Applications,” *IEEE Transactions on Microwave Theory and Techniques*, vol. 72, no. 3, pp. 1467-1479, Mar. 2024.

[12] P. Wang, Z.N. Li, C. Luo, Z.H. Wei, T. Wu, W. Jiang, T. Hong, Y. Li, G. F. Pedersen and M. Shen, “Preprocessing-Based Fast Design of Multiple EM Structures With One Deep Neural Network,” *IEEE Transactions on Antennas and Propagation*, vol. 72, no. 5, pp. 4298-4310, May 2024.

KEYNOTE 04

Computational Intelligence for Unsupervised Design, Modeling, and Optimization of Antennas

Slawomir Koziel

Professor

Reykjavik University, Iceland

ABSTRACT

The talk summarizes recent research by our team on the unsupervised design of high frequency components and deep-learning-based antenna modeling. Several specific algorithms are discussed, including methods for specification-driven design of multi-band and broadband antennas using computational intelligence, design-ready surrogate modeling using recurrent and convolutional neural networks, feature-based inverse modeling, and behavioral modeling using repurposed pre-trained language models. Algorithm outlines are accompanied by design examples and benchmarking against state-of-the-art methods.

BIOGRAPHY

Slawomir Koziel received the M.Sc. and Ph.D. degrees in electronic engineering from Gdansk University of Technology, Poland, in 1995 and 2000, respectively. He also received the M.Sc. degrees in theoretical physics and in mathematics, in 2000 and 2002, respectively, as well as the PhD in mathematics in 2003, from the University of Gdansk, Poland. He is currently a Professor with the School of Science and Engineering, Reykjavik University, Iceland. His research interests include numerical modeling and optimization, computer-aided design, uncertainty quantification, machine learning, and computational intelligence for high-frequency design.

MAIN REFERENCES

[1] S. Koziel, W. Dou, P. Renner, A. Cohen, Y. Tian, J. Zhu, and A. Pietrenko-Dabrowska, “On Unsupervised Artificial Intelligence-Assisted Design of Antennas for High-Performance Planar Devices,” *Electronics*, vol. 12, no. 16, paper no. 3462, 2023.

[2] T. Haq and S. Koziel, “Unsupervised Design and Geometry Optimization of High-Sensitivity Ring Resonator-Based Sensors Using Artificial Intelligence Methods,” *Scientific Reports*, vol. 15, paper no. 17986, 2025.

[3] S. Koziel, A. Pietrenko-Dabrowska, and S. Szczepanski, “Versatile Unsupervised Design of Antennas Using Flexible Parameterization and Computational Intelligence Methods,” *Scientific Reports*, vol. 14, paper no. 29753, 2024.

[4] S. Koziel, K.C. Sahu, and A. Pietrenko-Dabrowska, “Comprehensive Modeling of Antenna Electrical and Field Responses Using Transformer-Inspired Decoder-Based Transposed Convolutional Neural Networks,” *IEEE Transactions on Antennas and Propagation*, vol. 74, no. 5, pp. 4112-4125, 2026.

[5] K.S. Sahu, S. Koziel, and A. Pietrenko-Dabrowska, “Recurrent Neural Networks With Attention Mechanisms and Dimensionality Reduction for Accurate Data-Driven Modeling of Antennas,” *Knowledge-Based Systems.*, vol. 335, paper no. 115274, 2026.

[6] S. Koziel, K.C. Sahu, L. Leifsson, and A. Pietrenko-Dabrowska, “Residual Deep Neural Networks for Design-Ready Inverse Modeling of Antennas Using Response Features,” *Under review*, 2026.

[7] S. Koziel, K.C. Sahu, A. Pietrenko-Dabrowska, “Precise Behavioral Modeling of Antenna Structures Using Repurposed Pretrained GPT-Style Decoder Transformers and Domain Confinement,” *Under review*, 2026.